SIEMENS

ARCADIS

SP

Quality Assurance

System

Image Quality Quick Test

Valid for:
VARIC/ORBIC
Beginning with VB11

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Print No.: SPR2-320.820.02.03.02
Replaces: SPR2-320.820.02.02.02

English
Doc. Gen. Date: 06.05

Document revision level

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NOTICE

When performing the work and tests described in the following, observe the product-specific safety information as well as the general safety information contained in TD00-000.860.01.

➪ **n.a.**

Notes and symbols

The signal words are used and classified in anticipation of the new Medical Solutions CS standard which is based on ANSI standard Z535.4.

Text emphasized in technical documentation has the following meaning:

⚠ **DANGER**	**DANGER indicates when there is an immediate danger that l e a d s to death or serious physical injury.**
⚠ **WARNING**	**WARNING indicates a risk of danger that m a y l e a d to death or serious physical injury.**
⚠ **CAUTION**	**CAUTION used with the safety alert symbol indicates a risk of danger that leads to slight or moderate physical injury and/ or damage to property.**
NOTICE	**NOTICE used without the safety alert symbol indicates a risk of danger that if disregarded leads or may lead to a potential situation which may result in an undesirable result or state other than death, physical injury or property damage.**

Fig. 1: Safety Notes

System identification

Material no.: _____ Serial no.: _____
Customer/clinic: _____
Address: _____ City: _____
State/province: _____ Country: _____
Phone no.: _____ Contact person: _____
System no.: _____ Office: _____
Responsible system engineer: _____

System configuration:

23 cm I.I. ❒

Image quality acceptance in the factory performed completely and documented by:

Name (block letters): _____ Dept.: _____
Signature: _____ Date: _____

Customer installation date: _____

IQ quick test performed at:

Transfer to the customer during maintenance ❒

Settings deviating from the standard based on:

Country-specific regulations ❒ Spec. customer wishes ❒

Reasons: _____
_____

Name (block letters): _____ Office: _____

Signature: _____

Required measuring equipment and tools

• Set of X-ray filters, 10 x 0.3 mm Cu		44 06 120 RV090
• Precision X-ray filter, 2.1 mm Cu		99 00 598 XE999
• 25 mm AL measuring stand, type 26765 acc. to DIN 6868 Part 50 or 1.2 mm Cu from the X-ray filter set 17 m Cu strips		97 98 596 G5321 and 11 67 662 G5247
• Resolution test set type 41		28 71 820 RE999
• Densitometer	e.g. X-Rite 331 or PTW-BC21 including black check Type 5321 and light box type 53213	97 02 416 Y1996
• Dynamic test case		37 90 156 X1963
	or	97 50 001 X1963
containing:	TV dynamic test	37 90 164 X1963
	Heart contour diaphragm	37 90 172 X1963
	Capillary test	37 90 180 X1963
	Bracket	87 13 901 X1963
	Veiling glare test	87 09 743 X1963
• SMfit Spotmeter		77 52 848
• 3D calibration phantom		75 51 620 G5486

Requirements

Basic measuring conditions

- Completely functioning system; ensure that
  - Grid,
  - Tube assembly with collimator and 2.1 mm Cu are installed.
- Dose rate (I.I. input) of the "standard dose" level in FLUORO means: (full format; setting tolerance + 15 %). Dose rate (I.I. input) of the "standard dose" level in DR means: (full format; setting tolerance + 15 %).

23 cm I.I.: 0,185 µGy/s - fluoro

- The setpoints listed in the following chapters apply for a "medium" dose level; in the case of deviating settings, setpoints may have to be adapted.
- When requested to switch
  - Noise reduction k-factor
  - Edge
  - Motion detection
  - Fluoroscopic characteristic
  - Or other parameters in the organ programs, select or change a correspondingly predefined organ program or, if possible, change the parameter directly in the examination task card.

NOTE	**Use only the program stated in the IQ test. Deviations are pointed out explicitly.**

NOTE	**Perform only in the factory.**

Checking the monitors

- To load the test images on the ASPIA live monitor, call up the following items under Options in the sequence stated:
- Call up local service
- Load test images

  Call up **patient**→ **patient list** → **local database**→ **service patient**→ **test images**→ and load **test images**.
- **Eizo color monitor and SIEMENS color monitor DSC 1904-D:**
  - Luminance setpoint: 200 +20/-20 cd/m^2 in the delivery state.
  - The monitor is worn out when the maximum adjustable luminance is less than **120** cd/ m^2.
- **BARCO monochrome monitor:**
  - Luminance setpoint: 410 +20/-20 cd/m in the delivery state.
  - The monitor is worn out when the maximum adjustable luminance is less than **350** cd/ m^2.
- All gray scale values must be clearly visible on the monitor, especially the 5% and 95 % fields. (Select the test image via the scroll bar, see next page).
- Then measure the 100 % (white) and 0 % (black) fields with the SMfit Spotmeter.
- Check the brightness of the monitors and adjust it if necessary.

Monitor type	**Luminance in cd/m^2**		**Ambient light sensor* active**	**Remarks**
	0% field	100% field		
17" TFT (Eizo)	< 1	≥ 200 +20/-20	n.a.	*1, *2, *4
19” TFT (1904-D)	< 1	≥ 200 +20/-20	N/A	*1, *2, *4
18"B/W TFT (BARCO mon.)	0,9 ±0,1	≥ 410 +20/-20	No	*1, *2, *3, *4
***When shipped, the ambient light sensor is deactivated.				

Notes:

*1 Setting with 100% field with backlight

*2 The 5 % and 95 % fields must be visible. Setting: 5% with brightness control. Setting: 95% with contrast control.

*3 B/W TFT monitors are set with the ambient light sensor deactivated.

Setting of the 0% field brightness

Setting of the 100% field with backlight

*4 The luminance values indicated above, incl. tolerance data, are valid for new monitors.

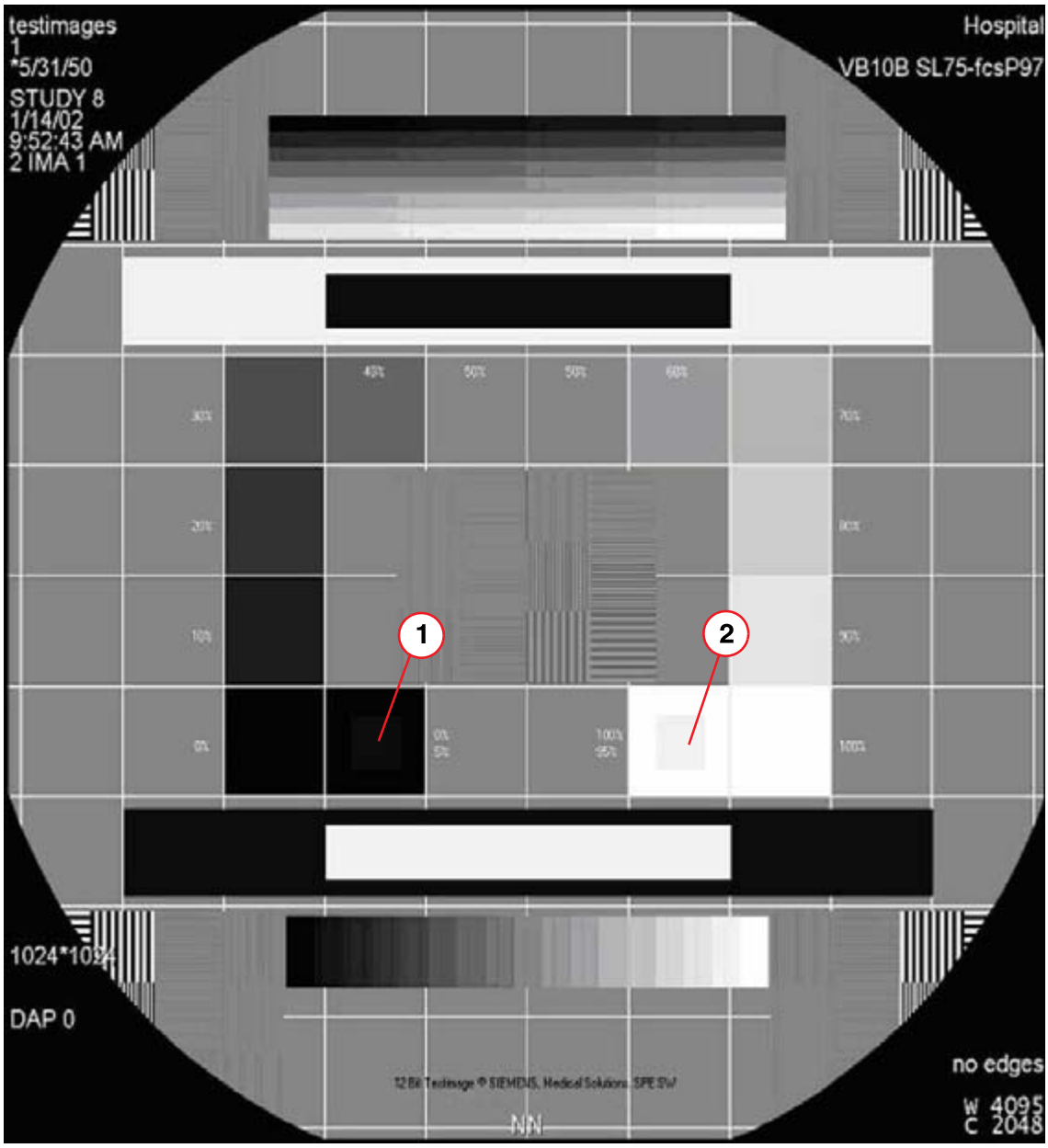

Fig. 2: SMPTE image (positive) bones black display

Pos. 1 5% field

Pos. 2 95% field

Orbic tableside control (overview)

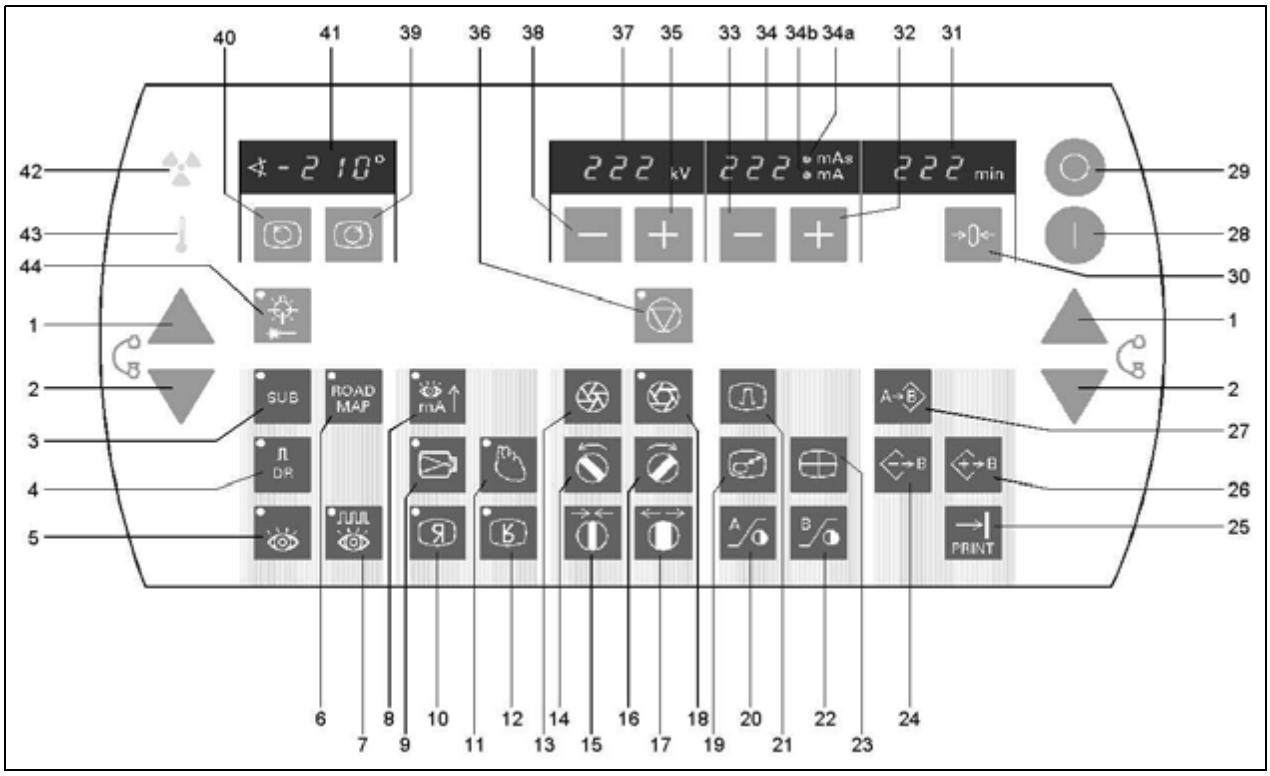

*Fig. 3: Control console_*

Button	Function
1	Raise lifting column
2	Lower lifting column
3	Subtraction (with LED)
4	Digital radiography (with LED)
5	Fluoroscopy (with LED)
6	Roadmap (with LED)
7	Pulsed fluoroscopy (with LED)
8	Power mode (with LED)
9	I.I. zoom (with LED)
10	Image rotation left/right (with LED)
11	Selection of the noise reduction factor (with LED)
12	Image rotation top/bottom (with LED)
13	Close iris diaphragm
14	Rotate the slot diaphragm to the left

15	Close the slot diaphragm
16	Rotate the slot diaphragm to the right
17	Open the slot diaphragm
18	Open the iris diaphragm
19	Electronic zoom
20	Contrast setting (LUT selection) for monitor A
21	Edge enhancement
22	Contrast setting (LUT selection) for monitor B
23	Screen split
24	Read image from memory (-)
25	Activate documentation unit
26	Read image from memory (+)
27	Save image
28	Switch on the system
29	Switch off the system
30	Reset fluoro buzzer
32	mAs adjustment (+)
33	mAs adjustment (-)
35	kV(mA) adjustment (+)
36	kV regulation stop (with LED)
38	kV(mA) adjustment (+)
39	Image rotation right
40	Image rotation left
44	Laser light localizer (with LED)

- **Button LEDs (red)**

LED in button	Function
3	Lights when subtraction is selected
4	Lights when digital radiography is selected
5	Lights when fluoroscopy is selected
6	Lights when the SUB "Roadmap" mode is selected

7	Lights when pulsed fluoroscopy is selected
8	High-contrast fluoroscopy (with LED)
9	Lights when I.I. zoom is selected
10	Lights when image rotation left/right is selected
11	Lights when a smaller K factor is selected
12	Lights when image rotation top/bottom is selected
18	Lights when the iris diaphragm is completely open in the exposure position
36	Lights during kV regulation in stop operation
44	Lights when the laser light localizer is switched on

- **LEDs in the display (red)**

LED in button	Function
34a	Lights when exposure (mAs) is selected
34b	Lights when the exposure mode is not selected (mA)

- **LED display surface**

LED	Function
42	Display lights when radiation is released
43	Display lights at a tube temperature of > 50 ^{o}C and blinks at a tube temperature of > 70 ^{o}C

- **7-segment display**

Display	Function
31	Fluoro time
34	mA/mAs display
37	kV display
41	Image rotation display

Varic tableside control (overview)

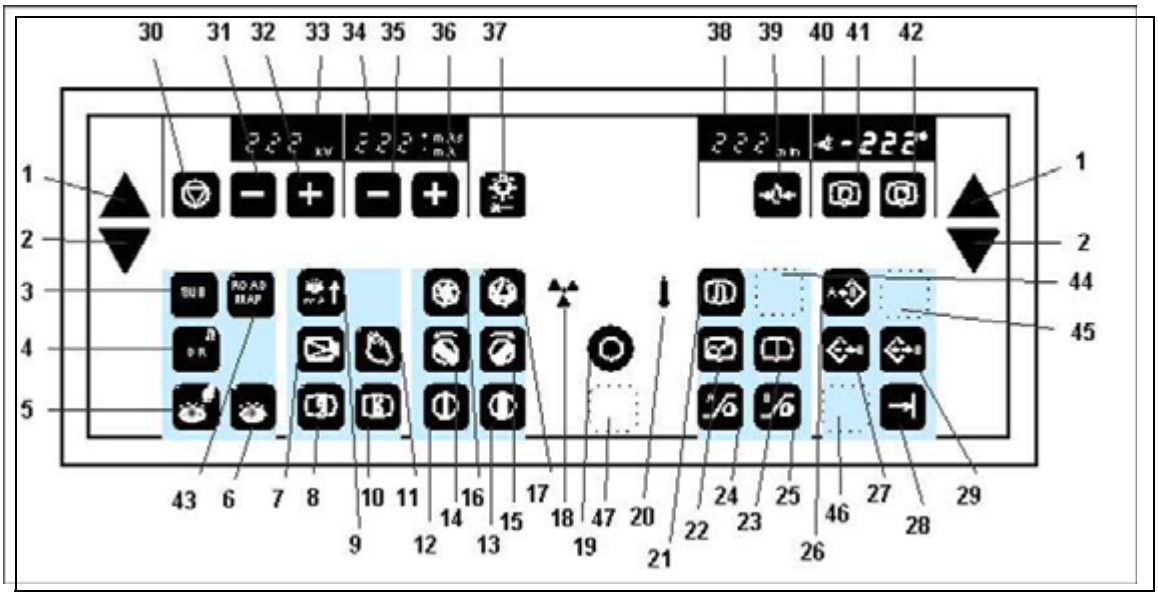

Fig. 4: Control console

Button no. .	Function	Remarks
1	Upward lifting column	
2	Downward lifting column	
3	Subtraction mode (SUB)	Button with LED
4	Digital radiography mode (DR)	Button with LED
5	Pulsed fluoroscopy mode (PFC)	Button with LED
6	Fluoroscopy mode (CFC)	Button with LED
7	I.I. zoom	Button with LED
8	Image rotation left/right (horizontal)	Button with LED
9	Power mode	Button with LED
10	Image rotation top/bottom (vertical)	Button with LED
11	Noise suppression (K factor selection change)	Button with LED
12	Filter diaphragm closed	
13	Filter diaphragm open	
14	Filter diaphragm - rotate left	
15	Filter diaphragm - rotate right	
16	X-iris diaphragm closed	
17	X-iris diaphragm open	Button with LED
19	Power off	

21	Edge enhancement	1
22	Memory (electr.) zoom	
23	Screen split	
24	Contrast setting - monitor A	
25	Contrast setting - monitor B	
26	Store image (during radiation ATB function)	
27	Read image from memory (-)	1
28	Activate documentation unit	
29	Read image from memory (+)	1
30	kV control stop	Button with LED
31	kV adjustment (-)	2
32	kV adjustment (+)	2
35	mAs adjustment (-)	2
36	mAs adjustment (+)	2
37	Laser light localizer on	Button with LED
39	Reset fluoro buzzer	
41	Image cursor left	
42	Image cursor right	
43	Roadmap mode (ROADMAP)	
44	Reserve 1	3
45	Reserve 2	3
46	Reserve 3	3
47	Power on	3

1. With autorepeat function, implemented in the image store
2. With autorepeat function starting from 1s at an interval of 0.3s
3. Equipped but not accessible from the front panel and not labeled

Requirements

- The standard settings are programmed for fluoroscopy, pulsed fluoroscopy and DR.
- Attach a 2.1 mm Cu precision X-ray filter for prefiltration in the area of the radiation exit (collimator).

Evaluation

NOTE

Check the programmed default organ programs. If other ADR control characteristics are to be programmed at the customer's request, first check the programmed default characteristics.

ADR control characteristics for the fluoroscopy mode

- Select FLUORO program 1 (see table 1). Standard dose.
- Select I.I. full format.

- Radiation on.
- Read off the kV and mA values displayed on the monitor.
- Radiation off.
- Enter the values in table 1.
- Select FLUORO program 2 (see table 1).
- Select I.I. full format.

- Radiation on.
- Read off the kV and mA values displayed on the monitor.
- Radiation off.
- The actual values documented in the factory must be obtained again at the place of use. Admissible deviations: Tube voltage (kV) ± 1 kV, tube current (mA) ± 10 %.

Tab. 1

	Program sequence	**ADR control characteristics (included in program)**	**Setpoints**		**Actual values**			
					Factory		**Place of use**	
			kV	mA	kV	mA	kV	mA
1	General head	HC 1	66 - 68	2.0 - 2.8				
2	General hip	HC 2	65 - 67	2.2 - 3.2				

NOTE

Perform only in the factory.

To check the ADR control characteristics for the pulsed fluoroscopy mode, "test" programs are to be created as subsequently described.

- Use the mouse to select the "Configuration of the examination program" menu on the top left screen edge under options/configuration and open it by double-clicking. Select the program for "general", "head", "standard dose".
- Select "copy".
- Confirm with "OK", enter the new name, e.g. "test", confirm with "OK".
- Select the new "test" program.
- Select "process".
- Select "fluoroscopy".
- Select a pulse rate of 5.0 under the "Pulsed" menu and confirm with "OK".

- Use the same procedure to create a program for "general", "hip", "test".
- Check the ADR control characteristics as subsequently described.

ADR control characteristics for pulsed fluoroscopy mode

- Select pulsed FLUORO, program 1 (see table 2), test.
- Select the highest pulse frequency (program 1 and 2).
- Select I.I. full format.

- Radiation on.
- Read off the kV and mA values displayed on the monitor.
- Radiation off. Enter the values in table 2.
- Select pulsed FLUORO, program 2 (see table 2).
- Select I.I. full format.

- Radiation on.
- Read off the kV and mA values displayed on the monitor.
- Radiation off. Enter the values in table 2.

Admissible deviations: Tube voltage (kV) ± 1 kV, tube current (mA) ± 10 %.

Tab. 2

	Program sequence	**ADR control characteristics, pulsed fluoroscopy (included in program)**	**Setpoints**		**Actual values**	
					Factory	
			kV	mA	kV	mA
1	General head test	HC1	65 - 66	14.5 - 20.8		
2	General hip test	HC2	65 - 66	16.3 - 23.0		

ADR control characteristics for DR mode

- Select the DR program (see table 3).
- Select I.I. full format.
- Radiation on.
- Read off the kV and mAs values displayed on the monitor.
- Radiation off.
- Enter the values in table 3.
- The actual values documented in the factory must be obtained again at the place of use. Admissible deviations: Tube voltage (kV) ± 1 kV, tube current (mA) ± 10 %.

Tab. 3

Program sequence	**DR takeover** **DR characteris-tics**	**Setpoints**		**Actual values**			
General information				**Factory**		**Place of use**	
Hip		kV	mAs	kV	mAs	kV	mAs
DR	n.a.	66 - 67	3,6 - 5,9				

Checking the image position

Requirement

Place a long, thin, straight object (e.g. stretched solder wire) near the I.I. - at an exact right angle to the C-arm orientation.

Place a second object next to it - for direction determination (see (Fig. 5 / p. 22)).

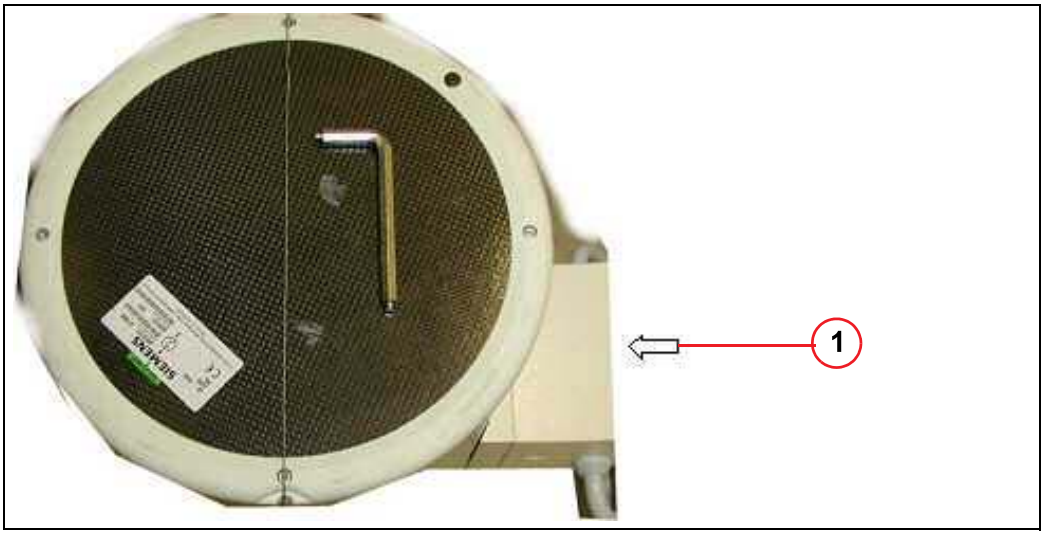

Fig. 5: Image position
Pos. 1 C-arm alignment

The rotation angle of the image on the display of the basic unit must be 0.

If necessary, set the angle to 0.

Record an image (see (Fig. 6 / p. 22)).

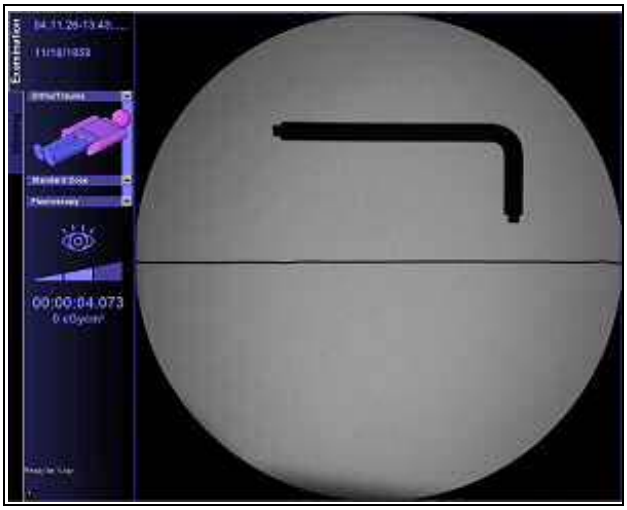

Fig. 6: Output image

Evaluation

The object must appear on the screen in an exactly horizontal position.

	Factory				Place of use				
Image position OK?	❒	Yes	❒	No		❒	Yes	❒	No

Checking the resolution and minimum contrast

Requirements

- Use a resolution test type 41 (factory and place of use).
- Set the edge enhancement to optimum resolution.
- Attach the resolution test directly to the I.I. grid in the center of the I.I. at an angle of approx. 45 degrees to the grid lines.
- In the factory: Place a 25 mm AL measuring stand on the I.I.
- Place of use: If the 25 mm AL measuring stand (with 0.4 mm recess) is available, attach it near the I.I., otherwise attach the 17 µm Cu strip directly to the I.I. grid next to the resolution test. Additionally place a 1.2 mm Cu filter in the beam path. Fading at the I.I. edge can be eliminated via collimation.
- Select an organ program (see table (Fig. 7 / p. 25)), standard dose.

- Radiation "on".
- Set the monitor contrast to optimum resolution.
- Set the edge enhancement to optimum resolution.
  - You can select the electronic zoom function and windowing in the viewer mask
- Radiation "OFF", determine the resolution of the LIH image and enter it in table (Fig. 7 / p. 25).

NOTE

If necessary, use the electronic zoom function and windowing in the viewer.

Mode	I.I. format	Resolution setpoints [lp/mm]	Resolution actual values [lp/mm]			
			Factory		Place of use	
		23 cm I.I.	Monitor 1	Monitor 2	Monitor 1	Monitor 2
FL Gen.Hip	Full format	≥ 1.8		n.a.		n.a.
FL Gen.Hip	Zoom 1	≥ 2.2		n.a.		n.a.
PFL Gen.Hip	Full format	≥ 1.8		n.a.		n.a.
PFL Gen.Hip	Zoom 1	≥ 2.2		n.a.		n.a.
DR (1000W) Gen.Hip	Full format	≥ 1.8		n.a.		n.a.
DR (1000W) Gen.Hip	Zoom 1	≥ 2.2		n.a.		n.a.

Fig. 7: Resolution_and_minimum contrast_table

Minimum contrast perceptible?

Factory					Place of use				
Full format	❑	Yes	❑	No	Full format	❑	Yes	❑	No
Zoom	❑	Yes	❑	No	Zoom	❑	Yes	❑	No

NOTE **Perform only in the factory.**

- Then remove the 25 mm Al or 1.2 mm Cu prefilter.
- Collimate to the resolution test.
- Perform the resolution test for DR again without prefilter as above:

Evaluation

Tab. 4

Operating mode (Organ program)	I.I. format	**Setpoints** **Resolution [lp/mm]**	**Actual resolution values [lp/mm]** **Factory**
		23 cm I.I.	Monitor 1
DR (1000W) (General, hip standard dose)	Full format	≥ 2.2	
DR (1000W) (General, hip standard dose)	Zoom 1	≥ 2.8	

Dynamic test

NOTE

The dynamic test in conjunction with the plexi capillary test is used to detect small contrast differences.

- **Measuring setup:**
  - Remove the 1.2 mm precision X-ray filter from the beam path
  - Attach the dynamic test without holder, with heart contour diaphragm and plexi capillary test right in front of the I.I. input screen (plexi capillaries close to I.I.).
- **Prerequisites:**
  - Organ program general hip (standard dose)
  - Select full format.
  - Select high noise reduction (heart button "off"). Button "11" on the control console.
  - Edge enhancement (button) off
  - Switch radiation on and evaluate the live image during radiation.
  - Select linear LUT (G1) on the basic unit.

- **Evaluation of the monitor image**
  - **Target value**

    The plexi capillaries not identified in (Fig. 8 / p. 27) must be visible.
- Check off non-visible plexi capillaries in (Fig. 8 / p. 27) (from left to right 2L →1→ 5R. Select the "medium" dose level.

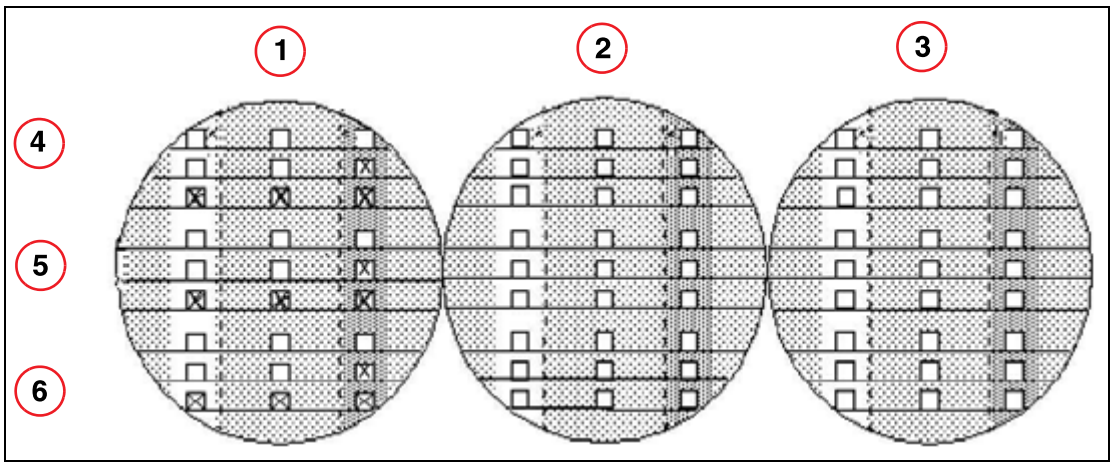

Fig. 8: Monitor image

Pos. 1	Target value
Pos. 2	Factory
Pos. 3	Place of use
Pos. 4	Group 3-mm wide
Pos. 5	Group 2-mm wide
Pos. 6	Group 1-mm wide

- Evaluation of the monitor image
- The plexi capillaries not identified in (Fig. 8 / p. 27) must be visible.

- Check off the non-visible plexi capillaries in the table of actual values (Fig. 8 / p. 27) .

Plexi capillary setpoints

- The plexi capillaries not identified in (Fig. 8 / p. 27) must be visible.
- Check off the non-visible plexi capillaries in the table of actual values (Fig. 8 / p. 27).

Subtraction mode

Measuring setup

- Attach the dynamic test without holder, with heart contour diaphragm and plexi capillary test right in front of the I.I. input screen (plexi capillaries close to I.I.).

Requirements

- Select full format.
- No edge enhancement.
- Select vascular application.
- Select hip (body region).
- Standard dose.
- Select subtraction.

Use

- Select LUT SUB2 on the basic unit (display on monitor)
- Trigger a scene (radiation on).
- After ≥ 3 seconds the mask is set automatically. Then cause the plexi capillary test to move by pressing the rubber ball.
- After another 3 seconds, switch the radiation off.
- Then, using the mouse in the scroll bar in the Viewer, select the image (scroll 2-3 images back) in which the white and black capillaries are visible most clearly.

Evaluation 1

- On monitor A, determine the capillary lines visible in the individual matrix fields separately for black and white. Enter the result in table (Fig. 9 / p. 29) and table (Tab. 5 / p. 29); mark any non-visible lines with an x.

NOTE	**Do not evaluate the first white line. Start the evaluation with the first black line.**

Black lines

	Setpoints			Factory			Place of use			
	2L	1	5R	2L	1	5R	2L	1	5R	Group
Black										top group 3 mm width
Black			X							
Black	X	X	X							
Black										middle group 2 mm width
Black			X							
Black	X	X	X							
Black										bottom group 1 mm width
Black			X							
Black	X	X	X							

Fig. 9: Operating mode Subtraction_black lines_tab

White lines

Tab. 5 Operating mode subtraction_white lines

	Setpoints			**Factory**			**Place of use**			
	2L	**1**	**5R**	**2L**	**1**	**5R**	**2L**	**1**	**5R**	**Group**
White										Top Group 3 mm Width
White			**X**							
White	**X**	**X**	**X**							
White										Middle Group 2 mm Width
White			**X**							
White	**X**	**X**	**X**							
White										Bottom Group 1 mm Width
White			**X**							
White	**X**	**X**	**X**							

Evaluation 2

- On monitor A, evaluate the white, 3-mm capillary line in fields 2L, 1 and 5R. There may not be any noticeable difference in brightness in the fields.

No noticeable difference in brightness	Factory		Place of use	
Visible in fields 2L, 1 and 5R:	❑Yes	❑ No	❑Yes	❑ No

Roadmap mode

Measuring setup

- Attach the dynamic test without holder, with heart contour diaphragm and plexi capillary test right in front of the I.I. input screen (plexi capillaries close to I.I.).

Requirements

- Select full format.
- No edge enhancement.
- Select vascular application.
- Select hip (body region).
- Select standard dose.
- Select roadmap.
- Select LUT SUB2 on the basic unit (display on monitor)

Use

- Trigger a scene (radiation on; phase 1).
- After ≥ 3 seconds the mask is set automatically.
- Do not move the plexi capillaries. (Radiation remains on; phase 2)
- After another 3 seconds, switch the radiation off.
- Switch radiation on again (phase 3).
- Cause the plexi capillary test to move by pressing the rubber ball.
- After another 3 seconds, switch the radiation off.
- Then, using the mouse in the scroll bar in the Viewer, select the image (scroll 2-3 images back) in which the white and black capillaries are visible most clearly.

Evaluation

- On monitor A, determine the capillary lines visible in the individual matrix fields separately for black and white.
- Enter the result in table (Fig. 10 / p. 31) and table (Fig. 11 / p. 31); mark any non-visible lines with x.

NOTE

Do not evaluate the first white line. Start the evaluation with the first black line.

Black lines

	Setpoints			Factory			Place of use			
	2L	1	5R	2L	1	5R	2L	1	5R	Group
Black										top group 3 mm width
Black		X	X							
Black	X	X	X							
Black										middle group 2 mm width
Black		X	X							
Black	X	X	X							
Black										bottom group 1 mm width
Black		X	X							
Black	X	X	X							

Fig. 10: Operating mode Roadmap_black lines_tab

White lines

	Setpoints			Factory			Place of use			
	2L	1	5R	2L	1	5R	2L	1	5R	Group
White										top group 3 mm width
White		X	X							
White	X	X	X							
White										middle group 2 mm width
White		X	X							
White	X	X	X							
White										bottom group 1 mm width
White		X	X							
White	X	X	X							

Fig. 11: Operating mode Roadmap_white lines_tab

Tolerance value: ± 15 %

Pixelshift function

Prerequisite:

The subtraction image from the Roadmap test is available.

- Select the roadmap image in the viewer.
- Select pixelshift in the SUB task card.

- Using the arrow tool, move the mask in all directions, one after the other:
  - Apart from the black and white edge strips, no artifacts must occur.
- Using the Auto Pixelshift tool, select a location:
  - In this location the shifted mask must return to artifact-free superimposition.

	Factory				Place of use				
Pixelshift function ok?	❒	Yes	❒	No		❒	Yes	❒	No

Edge enhancement, contrast enhancement and object movements

Requirements

- Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test on the table, see chapter 4, figure 1.
- Select organ program general, hip. Standard dose.
- Set the monitor contrast to linear.
- Edge enhancement = (off) (minimum is 10%).

Edge enhancement

- Release fluoroscopy briefly.
- Assessment of the edge enhancement in the LIH image.

Press the button for edge enhancement on the control panel. This successively selects the individual edge enhancement levels (20% or 40%).

Evaluation of the monitor image

	Factory				Place of use				
Edge enhancement function OK? => The bright-dark transitions become clearer when reselecting edge enhancement.	❒	Yes	❒	No		❒	Yes	❒	No

LUT selection change

- Release fluoroscopy briefly.
- Press the key for LUT selection change; the contrast of the image changes.

Evaluation of the monitor image

	Factory				Place of use				
LUT selection change function OK?	❒	Yes	❒	No		❒	Yes	❒	No

Motion unsharpness

- Select organ program (general, hip, standard dose).
- Use a stand to place the dynamic test without holder but with heart contour diaphragm and plexi capillary test in the beam path close to the I.I.

- In addition, place a screwdriver centrally on the dynamic test.
- Radiation on.
- With the radiation switched on, move the C-arm slightly in the horizontal direction; the screwdriver creates a smearing effect on the monitor.
- Radiation off.

- Select pulsed fluoroscopy max. pulse frequency organ program (general, hip, test).
- Radiation on.
- With radiation switched on, move the C-arm slightly in the horizontal direction; the screwdriver is displayed multiple times and with high definition.
- Radiation "off".
- Remove the stand with the dynamic test from the beam path.

Evaluation of the monitor image

	Factory				Place of use				
FLUORO, pulsed FLUORO functions OK?	❒	Yes	❒	No		❒	Yes	❒	No

Comments

_____
_____
_____
_____
_____

NOTE	**Delete the previously created "test" programs for "head" and "hip".**

NOTE	**Perform only in the factory.**

	ADR	With approx. 6 mm Cu and dynamic test in the beam path
	TV iris diaphragm control	With approx. 8.1 mm Cu and dynamic test in the beam path

The following controls are active in the case of the indicated prefiltrations. The test checks the function of these controls.

Requirements

- Both monitors must be set to approximately the same brightness and contrast impression (synchronism) (LUT, brightness and contrast setting).

Preparations

- Attach the dynamic test to the image intensifier:
  - Without holder
  - With heart contour diaphragm
  - Without plexi capillary test
- Select program general, hip, standard dose.
- Set the edge enhancement to maximum perceptibility of bright/dark transitions.
- Switch the I.I. to full format.
- Completely open the collimator.
- Prefilter with Cu until 105 kV to 109 kV are displayed. To do this, switch on fluoroscopy briefly (required in approx. 6.5 mm - 8 mm Cu).

- Radiation on.
- Assess the brightness of the fluoroscopic image.
- Radiation off.
- Store the LIH image and display it on the reference monitor.

TV iris diaphragm control

- Additionally attach 2.1 mm Cu to the radiation exit.

- Radiation on; the generator limit of 110 kV/5 mA must be reached.
- Store the LIH image as a reference image.
- Radiation off.
- Store the image and display it in the viewer.
- Assess the brightness of the fluoroscopic image.

The brightness impression with approx. 6 mm Cu prefiltration and dynamic test should be approximately the same as the brightness impression with approx. 8.1 mm Cu and dynamic test.

Evaluation

	Factory	
Same brightness impression with ADR and TV iris diaphragm control	❑Yes	❑ No

Auto Gamma check

NOTE	**Perform only in the factory.**

- Requirements
  - Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test on the I.I. input screen.
  - Select organ program (general, hip, standard dose).
  - Set the monitor contrast to linear.
  - Edge enhancement = on
  - No additional copper in the beam path

Reading off the center (brightness) values

- Check as follows:
  - Store the fluoro image (ATB buttons or automatic LIH transfer).
- Evaluate the fluoro image in the viewer as follows:
  - Select**Option ---> Local service** ↵ in the menu bar of the imaging system.
  - Enter the password and minimize the service window
  - Select the last image in the viewer
  - In the Tools menu bar of the imaging system, select **Measure ---> Rectangle** ↵.
- Operating principle:
  - The mouse pointer is visible with the position pointer
  - Press the left mouse button and draw a rectangular measuring field of up to approx. 2 cm x 15 cm.

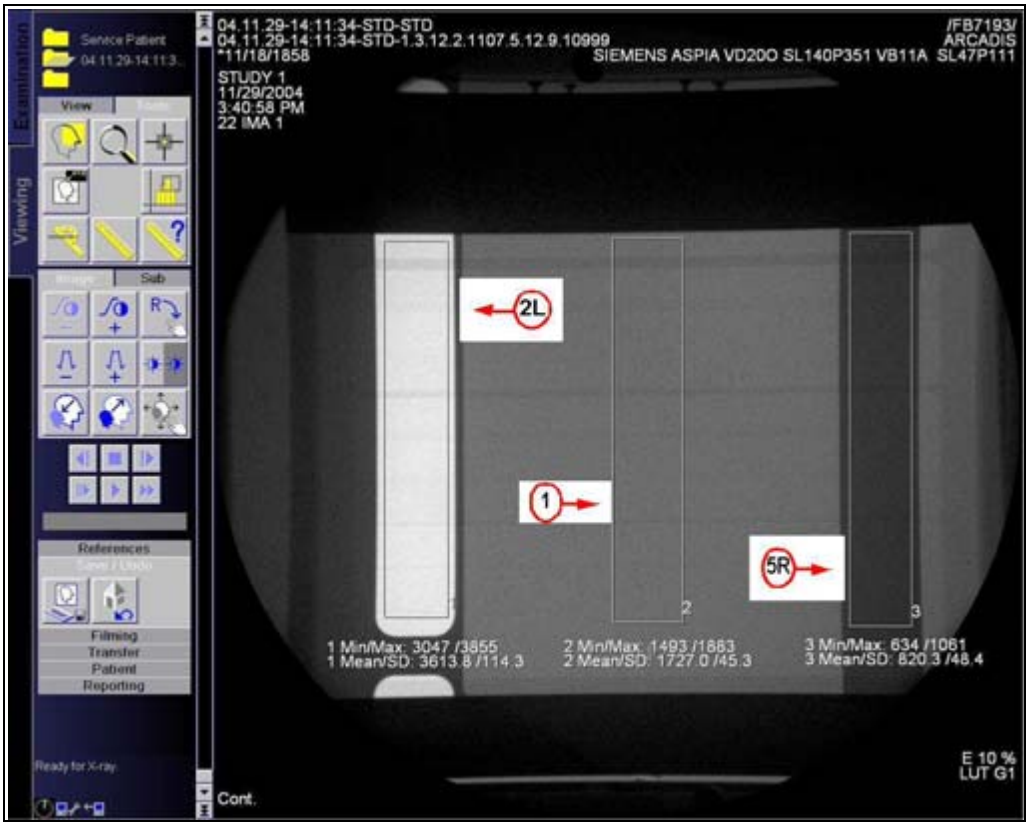

*Fig. 12: Display values_*

Read off the center value.

NOTE	**The brightness value of the next darker measuring area should be 40-60% of the brighter measuring area.**

Auto Gamma function OK?	❑Yes	❑ No

NOTE	**Perform only in the factory.**

Checking camera rotation

Prerequisites same as for the Auto Gamma check.

- Edge enhancement on
- Set the following angles and record an image for each angle.
- Then evaluate the images for artifacts in the viewer.

Angles to be set (to be set on the C-arm control panel):

1°; 2°; 5°; 22°; 85°; 88°; 89°; 90°; 180°; 270°

- **Evaluation:**

Rotation function OK?	❑Yes	❑ No

Vignetting compensation

NOTE	**Perform only in the factory.**

- Remove the dynamic test.
- Select organ program general, hip, standard dose.
- Attach a 2.1 mm Cu prefilter close to the generator.
- Check the optical impression for uniform brightness across the entire image area.
- Using the service tool, the edge brightness decrease can be assessed according to the following example.

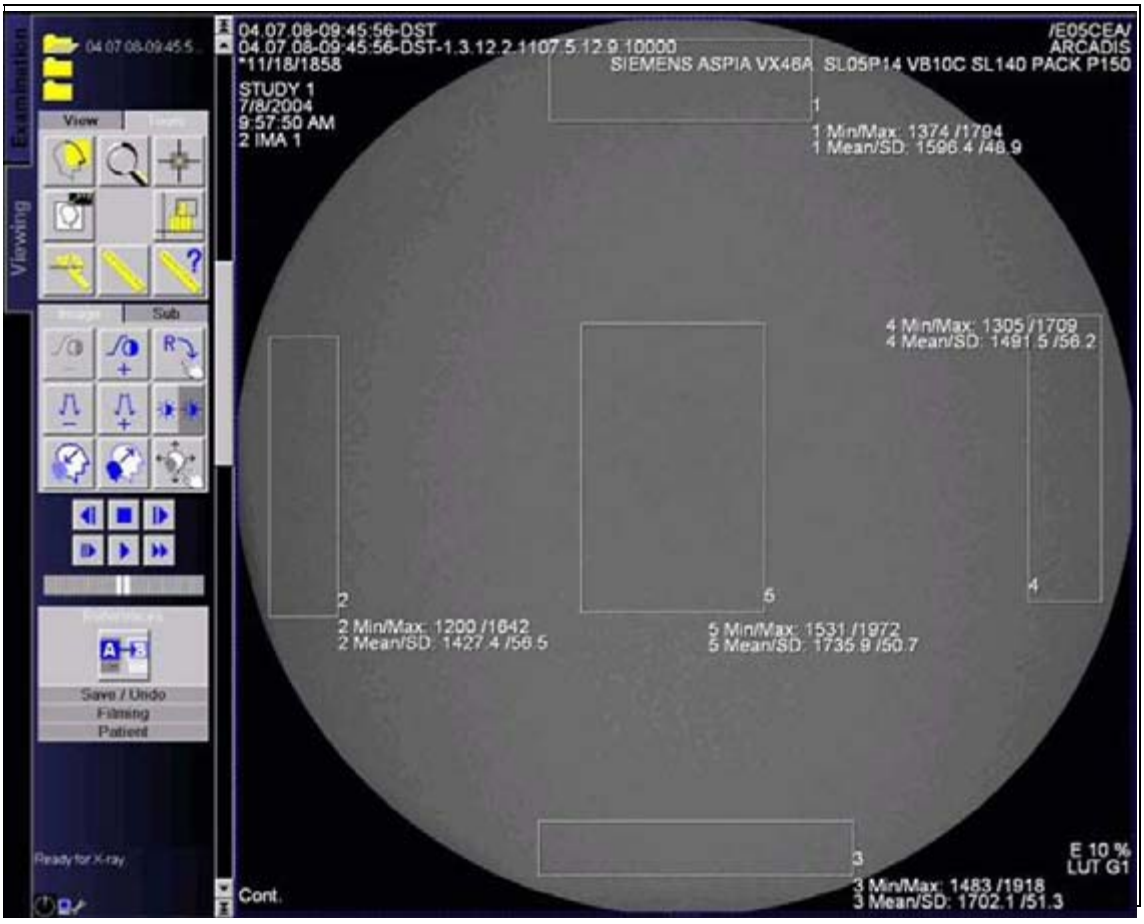

Fig. 13: Measuring field

The average value in the outer measuring fields should be at least 75% of the values in the center measuring field.

- Evaluation

Vignetting compensation OK?	❑Yes	❑ No

Image disturbances (artifacts)

- Check off all image disturbances determined during settings and IQ tests in the table in the IQ measuring protocol.
- If image disturbances are detected that are not listed in the table, describe them under "Other disturbances".
- Three assessment numbers indicating the extent of the disturbance are provided for each assessment of the relevant disturbance.

Definition of the assessment numbers

1 = No disturbances and artifacts were detected during start-up.

2 = Minor disturbances, artifacts occurred sporadically during start-up. The cause could not be localized and the "error" could not be corrected. The disturbances scarcely affect the good overall image impression, and the ability to make a medical diagnosis from the images is absolutely not impaired. Therefore, the artifacts are tolerable.

3 = During start-up, more frequent or stronger disturbances/artifacts occurred that disturb the overall impression of the image or impair the ability of the images to be diagnosed medically and are therefore no longer tolerable. The system must not be shipped or handed over to the operator in this condition.

Description of the artifacts

- **Hum:**

  Inconsistencies resulting from electromagnetic interference in the imaging systems are unattractive and disturbing. Depending on the nature of the disturbance, they can considerably impair the ability of the images to be evaluated and should ideally not occur at all. They are tolerable only to a very slight degree. Hum disturbances are visible as sporadic, horizontal light-dark patterns in the image; they are temporary and are not limited to a specific location.

- **Interference stripes:**

  Very high-frequency electromagnetic radiation is visible in the image as light or dark, sometimes very short horizontal lines (temporary). Interference stripes that are caused by dirt on optically effective surfaces must also be recorded here. They are limited to a specific location and are not temporary. Interference stripes are barely tolerable.

- **Ghost images:**

  These are object contours that are usually offset to one side and appear double. They are caused by reflections in poorly adapted, long video cables. Clearly visible ghost images are not tolerable.

- **Background structures** are permanent, grid-shaped patterns, primarily in dark image sections, that are also called "fixed noise".

- **Pixel errors** are image pixels without image information. They are visible on the monitor as dark or light pixel-size dots. There are tolerable and intolerable pixel errors. The TV camera is inspected very precisely in the test area for pixel errors and only TV cameras with pixel errors corresponding to an internal specification according to type and number are provided to customers. These tolerable pixel errors must be documented in the IQ measuring protocol.

Evaluation of the image disturbances

Setpoint for assessment of the disturbance: Only 1 and 2 are allowed.

	Factory			Place of use		
Nature of the disturbance, artifact	**Assessment of the disturbance *1**			**Assessment of the disturbance *1**		
	1	2	3	1	2	3
Hum						
Interference stripes						
Ghost images (reflections)						
Background structures						
Pixel errors ***2**						

Other disturbances:

_____

_____

_____

Comments:

_____

_____

_____

_____

_____

Remark: The image disturbance assessments must be recorded at the place of use.

***1** Assessment of the disturbances

1 = No disturbances, artifacts

2 = Slight disturbances, artifacts

3 = Intolerable disturbances, artifacts

***2** State the number and position of pixel errors under comments.

Camera/printer

Camera/printer available? If yes: camera type ..... If no: chapter not applicable.	❑Yes	❑ No

NOTE	**Also see General Hardcopy Information, SPR2-310.814.25.01.02 (CB-DOC).**

Functional check

- The functional check must be performed with all possible image segmentations, in each case with positive and negative image display. Definition: Positive image display means that the hardcopy image is identical to the monitor display.

Requirements

- Select the stored SMPTE test pattern in the viewer.
- Comply with a 20-minute camera warm-up phase.
- Select the image segmentation to be tested in each case.
- Select the image display (positive/negative) to be tested in each case.
- Enter the film type and emulsion number used.

NOTE	**Necessary only for wet film cameras.**

Evaluation

- Measure the exposed film with the densitometer.
- Enter the measured film density values in the following table.
- Record the setting values after the functional check.
- Groups of fine lines are displayed in the image center.
  - see SMPTE Fig. 1, chapter 1-5

	Place of use	
Test OK?	❑ Yes	❑ No

Comments:

_____

_____

_____

_____

	Film density				
Segmentation	**Gray-scale levels SMPTE**	**Film density *2 SET-POINT(start-up)**	**Film density SET-POINT (maintenance)**	**Film density ACTUAL (start-up)**	**Film density ACTUAL (maintenance)**
Full screen *1 negative image display (bones white)	0% 40% 100%	< 0.25 1.0 + 0.15 > 2.7	< = 0.27 1.0 + 0.2 > = 2.5		
Full screen positive image display (bones black)	0% 40% 100%	> 2.7 1.2 + 0.15 < 0.25	> = 2.5 1.2 + 0.2 < = 0.27		
Fourfold *1 negative image display (bones white)	0% 40% 100%	< 0.25 1.0 + 0.15 > 2.7	< = 0.27 1.0 + 0.2 > = 2.5		
Fourfold positive image display (bones black)	0% 40% 100%	> 2.7 1.2 + 0.15 < 0.25	> = 2.5 1.2 + 0.2 < = 0.27		
____fold *1 negative image display (bones white)	0% 40% 100%	< 0.25 1.0 + 0.15 > 2.7	< = 0.27 1.0 + 0.2 > = 2.5		
___fold negative image display (bones black)	0% 40% 100%	> 2.7 1.2 + 0.15 < 0.25	> = 2.5 1.2 + 0.2 < = 0.27		

NOTE	**3D resolution is only performed for ARCADIS Orbic 3D.**

NOTE	**The 3D calibration menu option can only be performed if the 3D adjustment menu option was already performed completely and successfully.**

Required material

Resolution test 28 71 820 RE999 (type 41)

Stand for the calibration phantom

Preparation

Place the C-arm in the horizontal position with the image intensifier to the basic unit, see (Fig. 14 / p. 47).

- Mount the resolution test horizontally on the stand for the calibration phantom.
- Position the resolution test in the isocenter of the C-arm, see (Fig. 15 / p. 47) and (Fig. 16 / p. 48).
- If available, the laser light localizer is to be used to determine the isocenter.

Fig. 14: Side view of the test setup

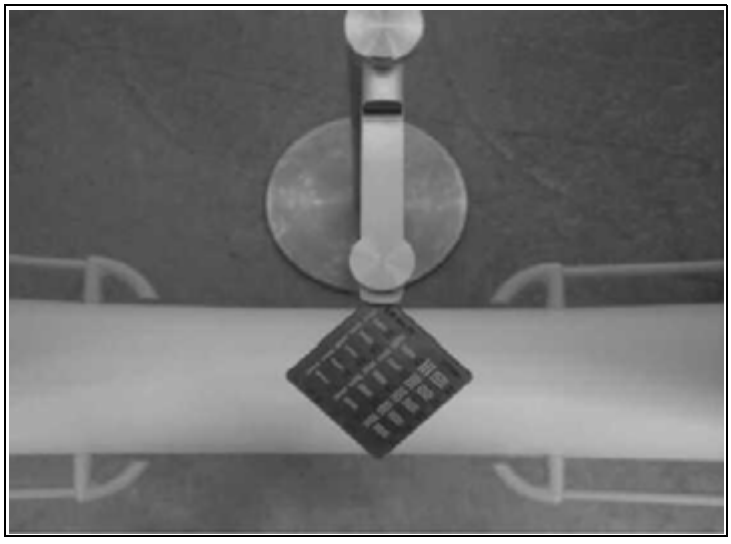

Fig. 15: Top view of the test setup

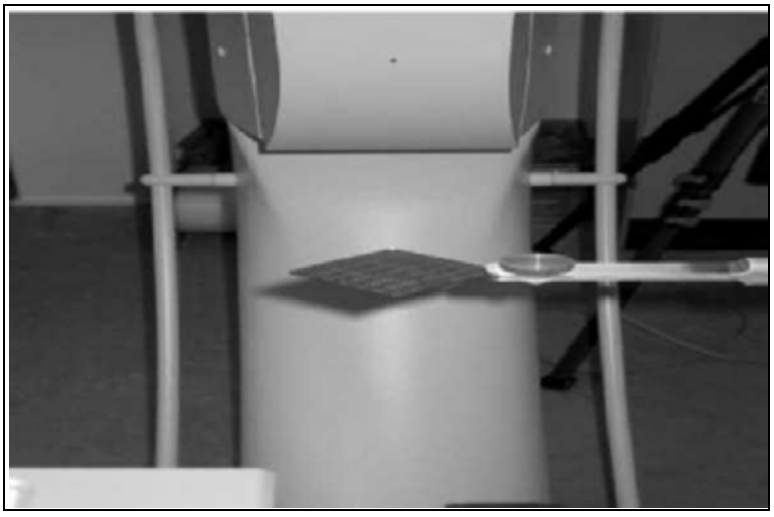

Fig. 16: Test setup as viewed from the I.I.

Testing

- Start the 3D scan by pressing the 3D button on the acquisition task card.
- The following exposure dialog is displayed on the right monitor (Fig. 18 / p. 50), and the syngo 3D task card is visible in the background (Fig. 17 / p. 49)

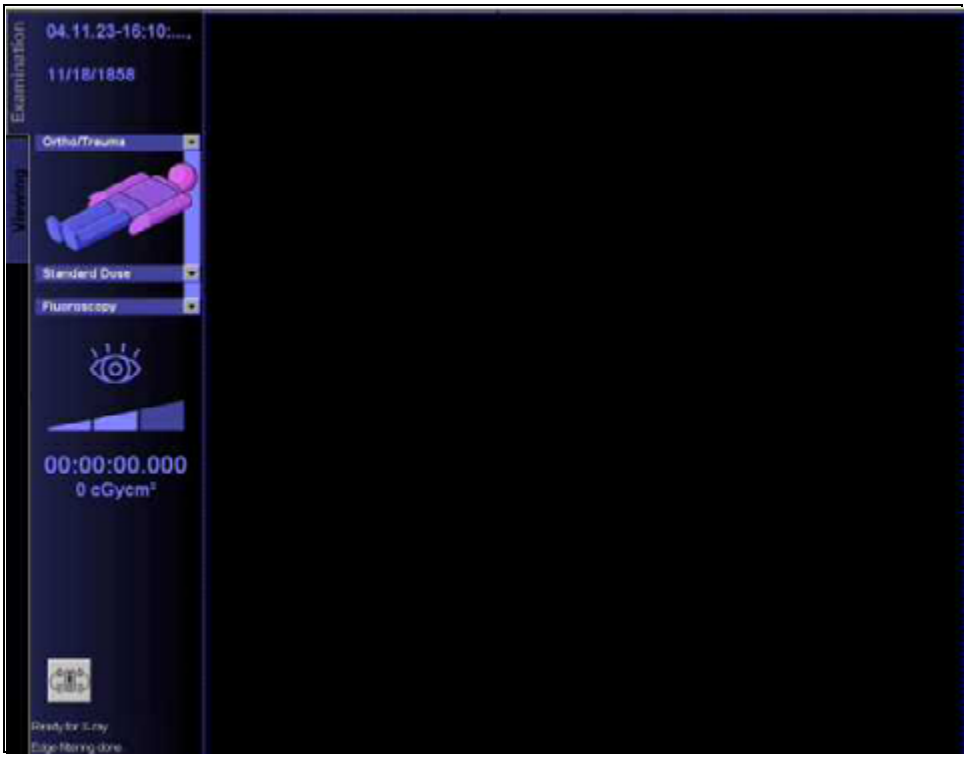

Fig. 17: syngo_start screen

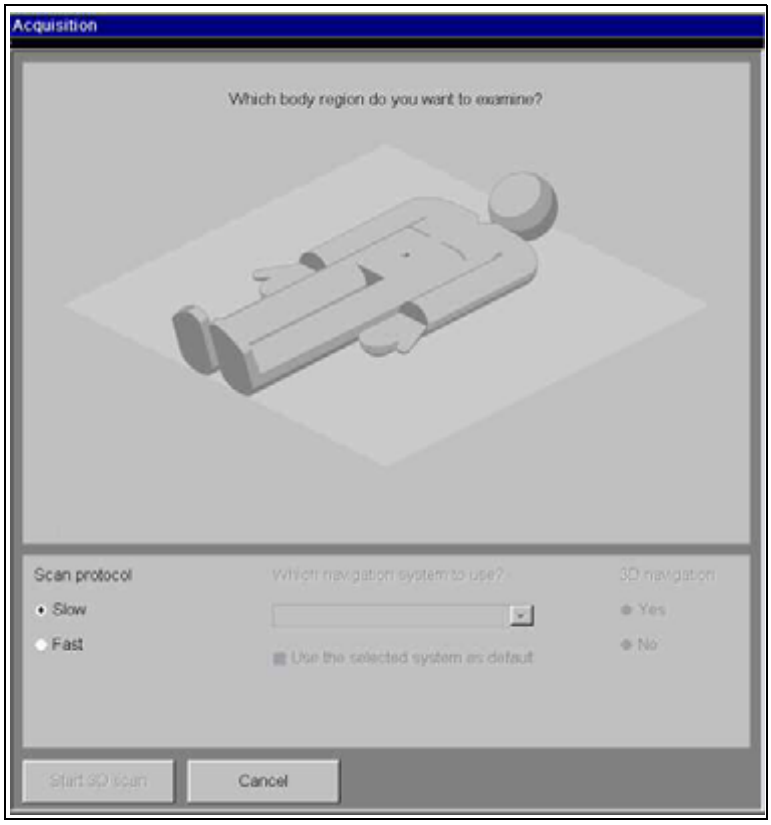

Fig. 18: Orientation menu

- Select a body region.

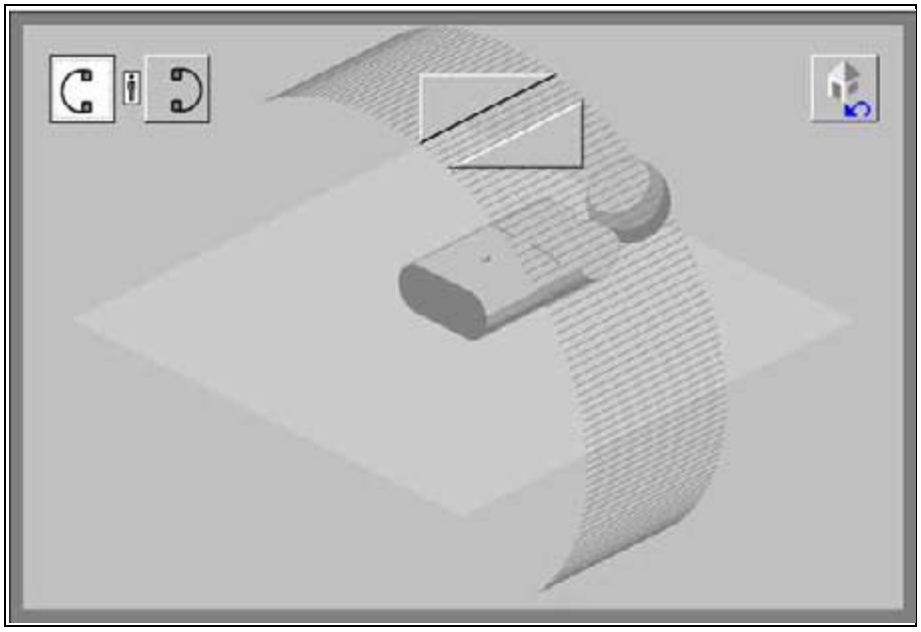

Fig. 19: Dialog box for patient position and beam direction

The indicated screen view is displayed, see (Fig. 19 / p. 50)

- Select the C-arm position.

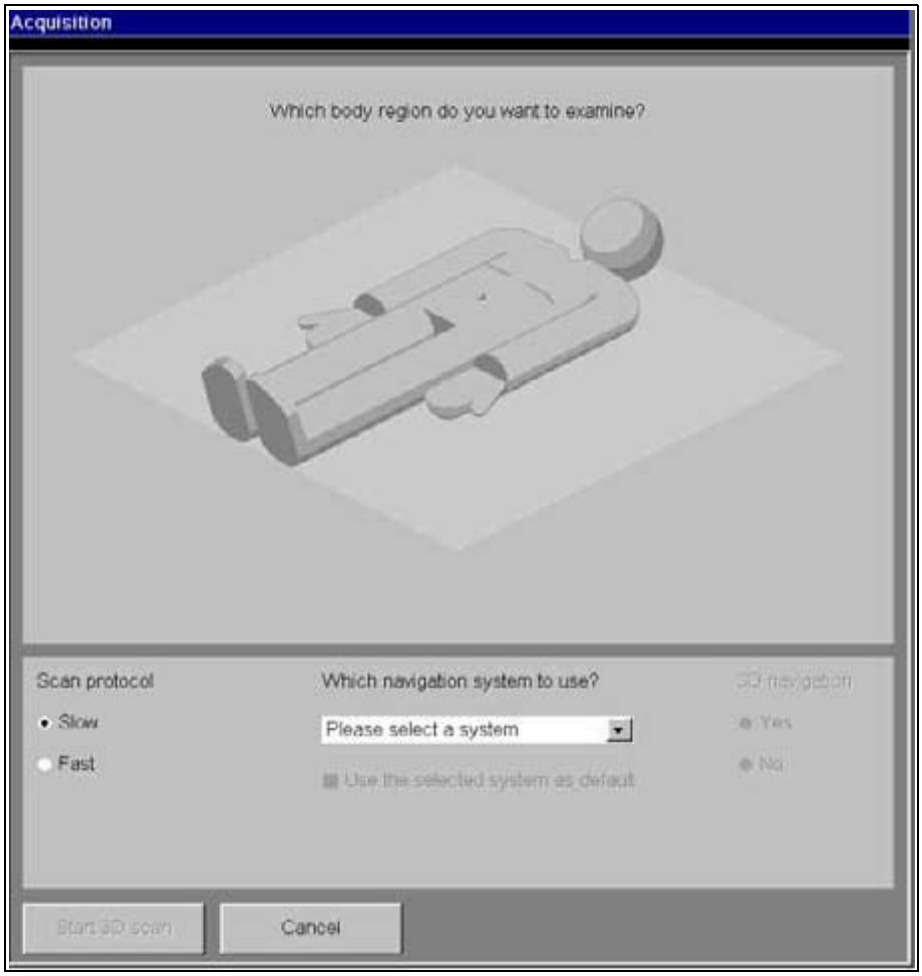

Fig. 20: Image 1

- Select the "slow" scan protocol
- Select a navigation system (none for Orbic 3D) (Fig. 20 / p. 51)Fig...
- Click the "start 3D scan" button.

The following screen view is displayed:

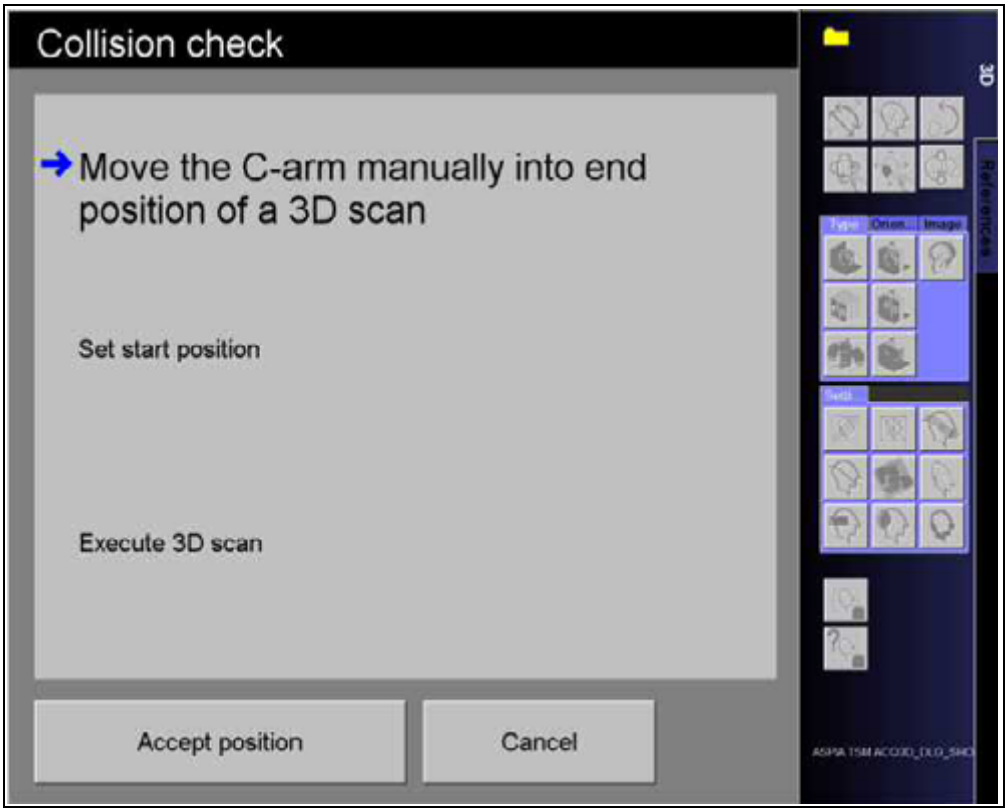

Fig. 21: Image 2

- Manually move the C-arm to the end position (to the limit switch).

The X-ray tube is then on the basic unit.

The following screen view is displayed (Fig. 22 / p. 53):

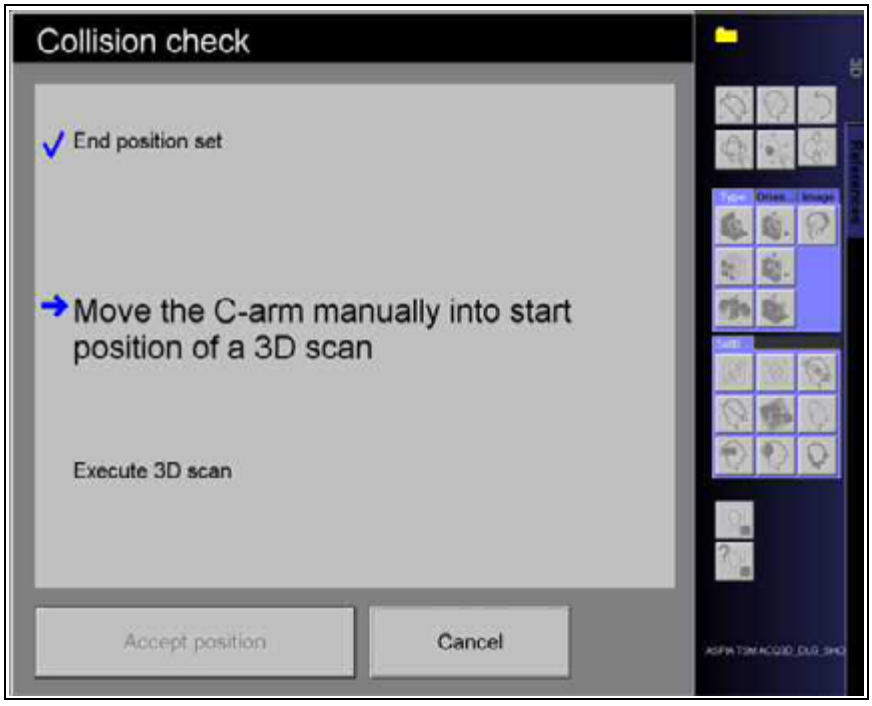

Fig. 22: Image 3

- Manually move the C-arm to the start position (to the limit switch).

The image intensifier is then on the basic unit.

After a successful manual test run, the following screen view is displayed (Fig. 23 / p. 53):

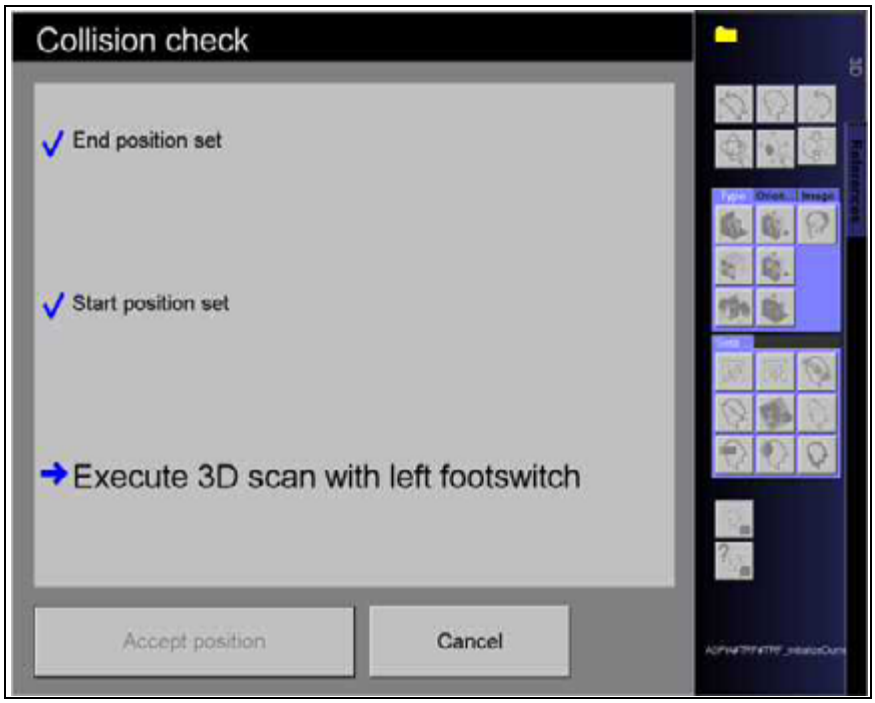

Fig. 23: Image 4

Measurement sequence

- Start the 3D scan with the left foot switch.
- Press and hold the foot switch until the scan is complete (approx. 1 minute)
- Monitor on the left monitor whether the resolution test remains in the isocenter.

Up to 1.8 lp/mm should be visible in 2D images.

Max. visible line pairs in 2D: .....

- The lead strip test must be positioned in the center of the monitor image.
- If the object position moves significantly out of the isocenter, the measurement must be stopped and the object must be repositioned.

The following image (Fig. 24 / p. 54) is displayed during the scan:

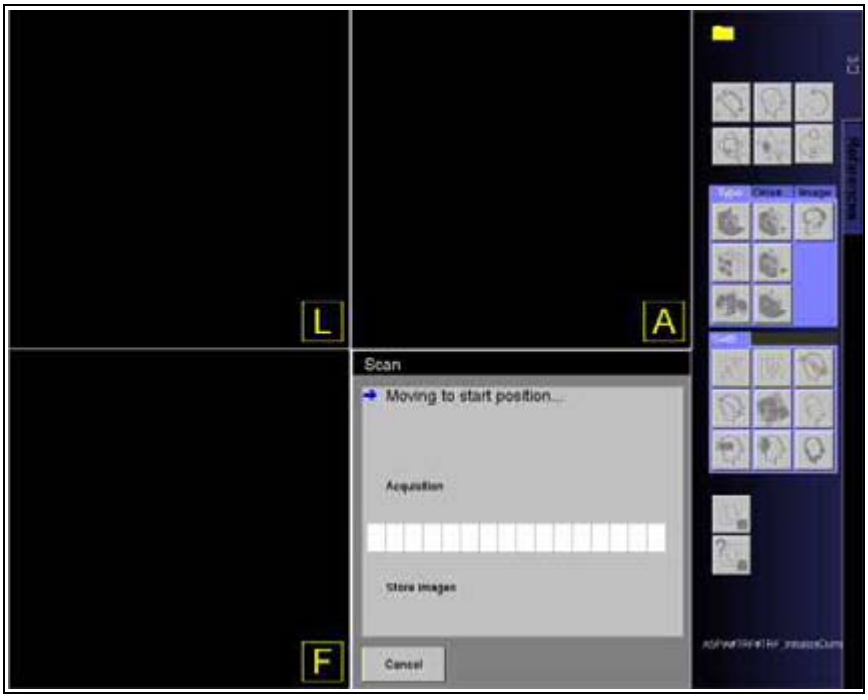

Fig. 24: Image 5

After a successful scan, the following image (Fig. 25 / p. 55) is displayed:

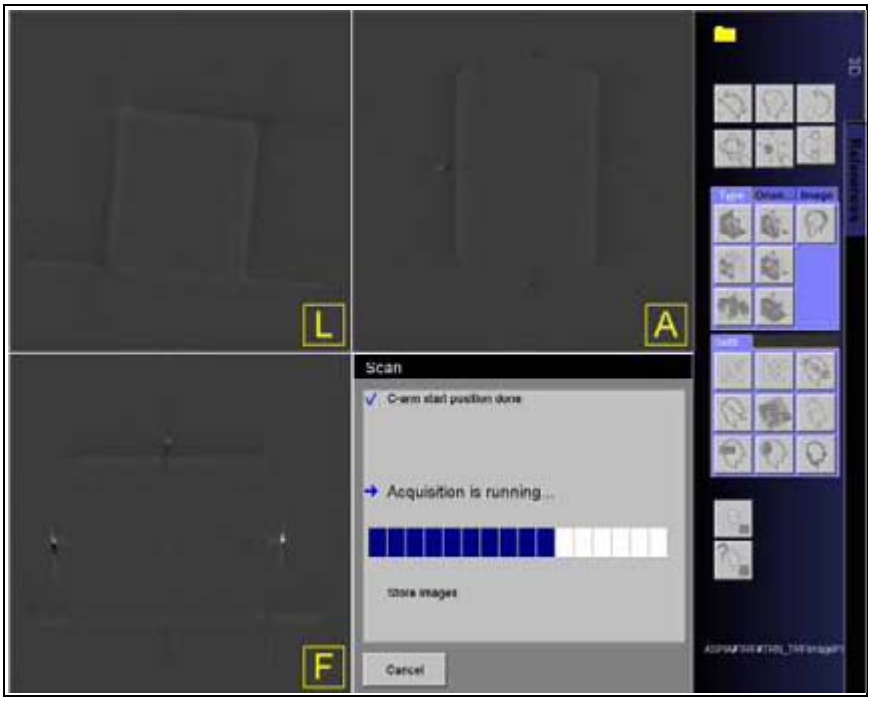

Fig. 25: Image 6

- Subsequently release the foot switch.

The reconstructed volume is automatically displayed in the MPR display in the 3D task card after recording (Fig. 26 / p. 56)

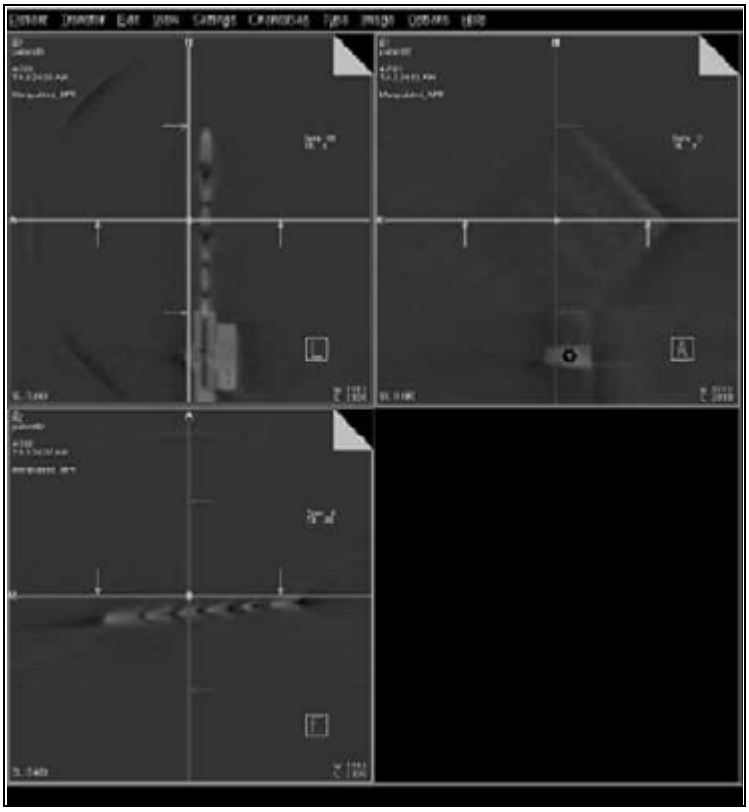

*Fig. 26: syngo image after successful recording and reconstruction_*

Checking 3D resolution

Procedure:

Determine the optimal slice plane for representing the lead strip test in the syngo window.

- Use the vertical selection bar to select the the plane directly through the lead strip test (Fig. 27 / p. 57)
- Then use the horizontal bar to select a slice plane in the center of the lead line grid (Fig. 28 / p. 57)

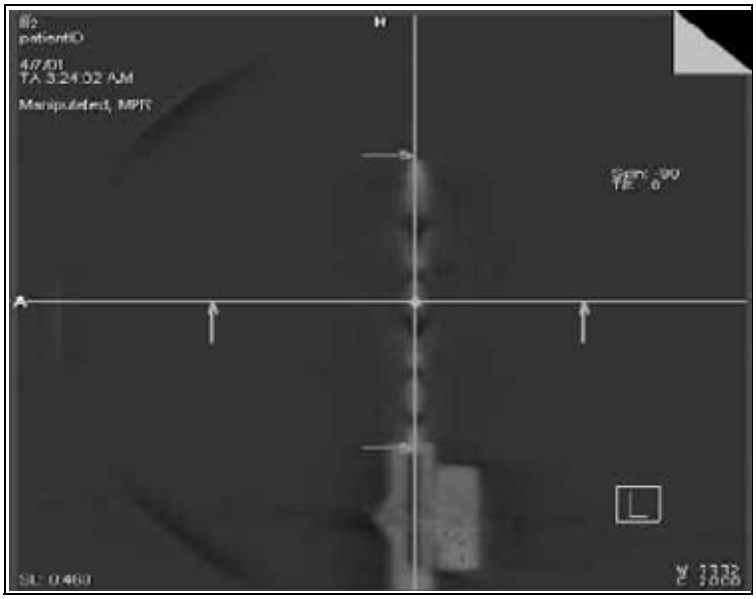

Fig. 27: Setting the slice plane in the top left window

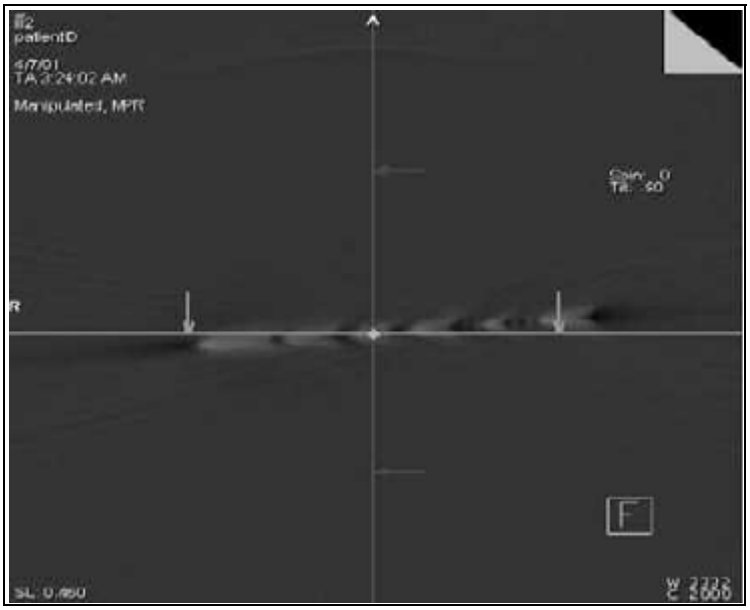

Fig. 28: Slice plane in the bottom left window

- If the lead strip test is tilted with respect to the display plane, the position of the slice plane is to be corrected with an open adjustment.
- A syngo image should show a slice plane parallel to the lead line grid, see (Fig. 29 / p. 58)

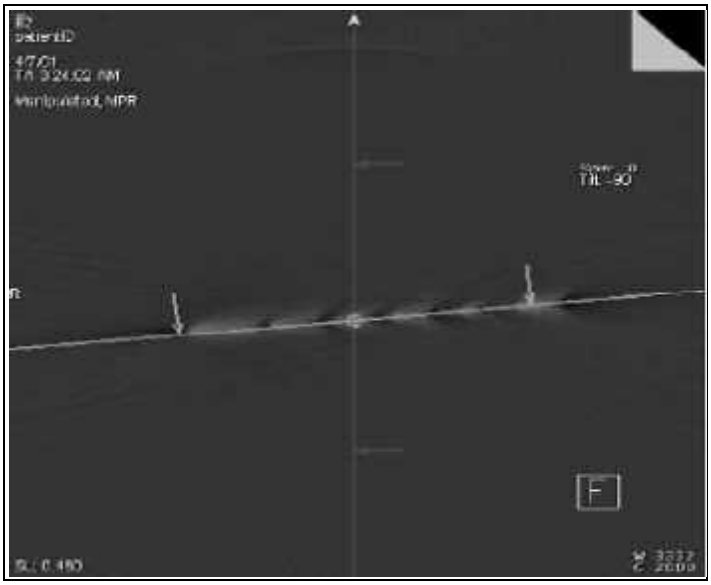

Fig. 29: Rotating the slice plane

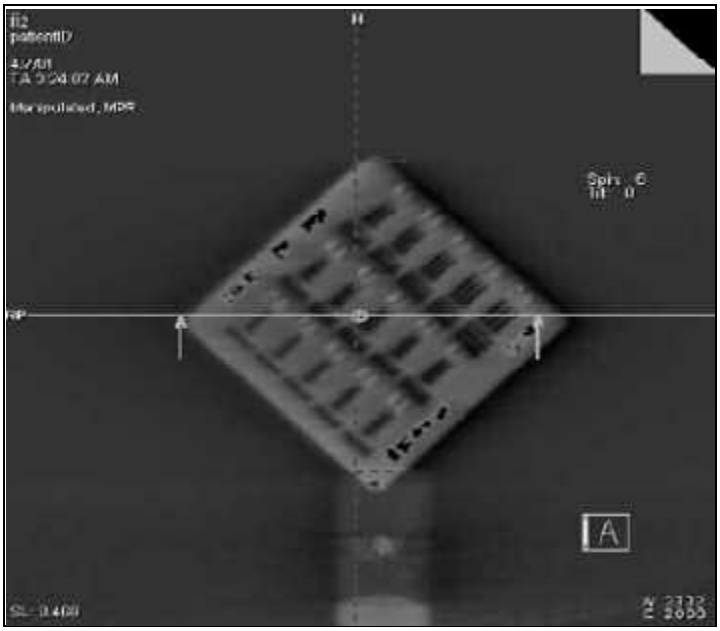

Fig. 30: Plane parallel to the lead strip test

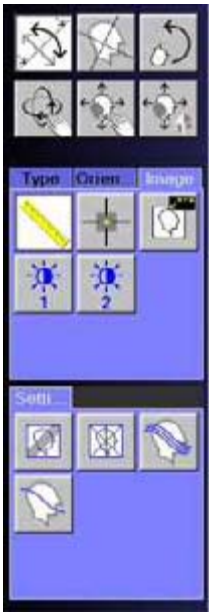

Fig. 31: Selection

- Subsequently generate a large image of the lead line grid by double-clicking on the "plane parallel to the lead strip test" image (see (Fig. 30 / p. 58)).
- Check the 3D resolution (1 lp/mm should be achieved). It may be necessary to observe several planes.

  Actual value: .....

	Factory	Place of use
3D resolution achieved:	❒ Yes ❒ No /	❒ Yes ❒ No /

- Use the measuring function (see (Fig. 31 / p. 59)) in syngo to measure whether the edge length of the high-resolution slide are perpendicular to one another. The edge length should be 50 mm ± 1.5 mm, and the edges should be approximately equal.

Edge length 1: ..... Edge length 2: .....

	Factory	Place of use
Edge length difference ≤ 1.5 mm:	❒ Yes ❒ No /	❒ Yes ❒ No /

Adjustment of the calibration phantom

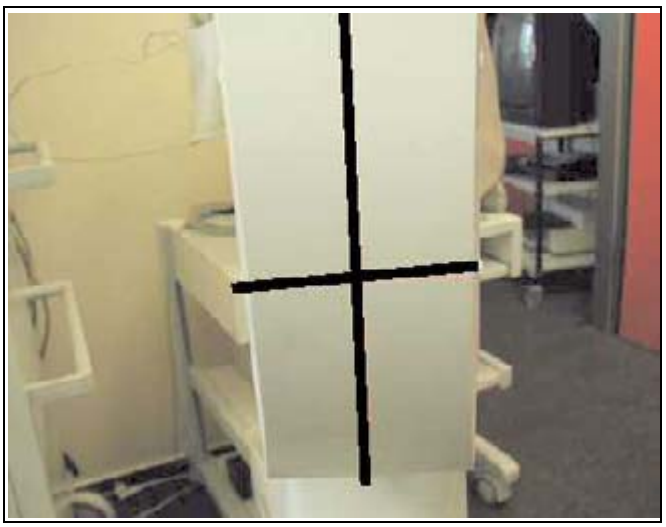

Fig. 32: Setting the I.I. light localizer correctly

Fig. 33: Calibration phantom

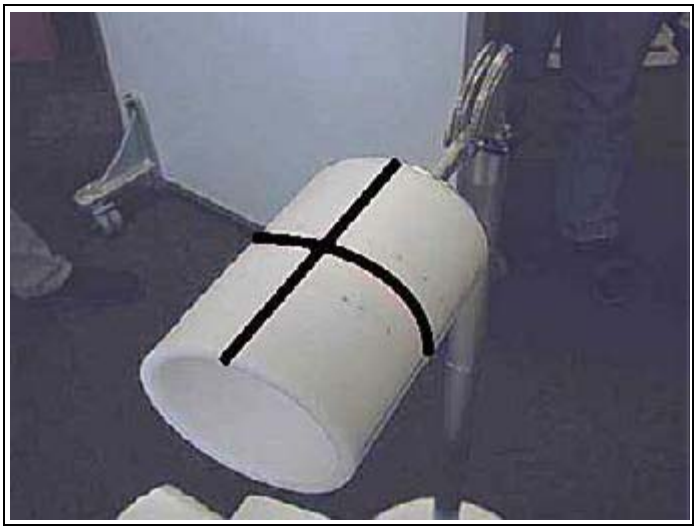

Fig. 34: Vertical adjustment

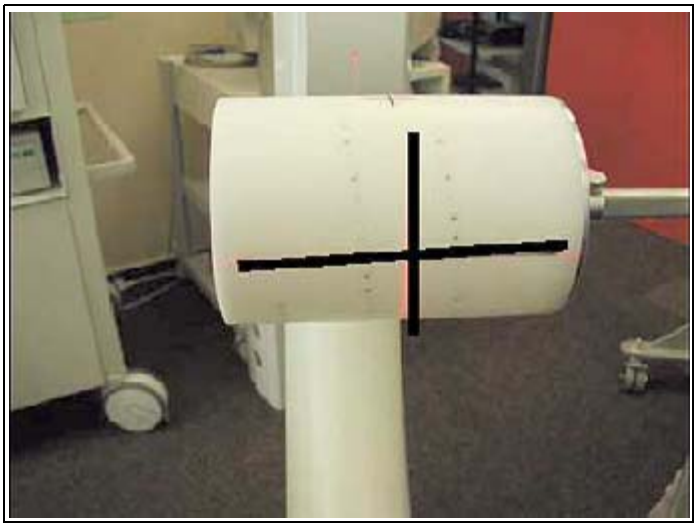

Fig. 35: Horizontal adjustment

- Take the required stand out of the "Calibration Phantom Service Case".
- Attach the calibration phantom to the stand.
- Set the laser light localizer to the tube center ((Fig. 32 / p. 60)).

Systems equipped with a laser light localizer:

- Position the calibration phantom in the C-arm ((Fig. 33 / p. 60)).
- Using the light laser localizer, align the C-arm correctly with respect to the markings on the calibration phantom, first in the vertical ((Fig. 34 / p. 61)) and then in the horizontal ((Fig. 35 / p. 61)) C-arm position.

Without a laser light localizer:

- Align the C-arm correctly with respect to the markings on the calibration phantom, first in the vertical ((Fig. 34 / p. 61)) and then in the horizontal ((Fig. 35 / p. 61)) C-arm position.

Release fluoroscopy briefly and monitor the position of the C-arm with respect to the calibration phantom (also see (Fig. 36 / p. 62)).

- Check that the calibration phantom is positioned in the isocenter. To do so, check both the horizontal and vertical adjustment at least 2x (see (Fig. 36 / p. 62)).

  ➪ Example of a correctly positioned calibration phantom. The tips of the sphere pattern must not be visible at the top and bottom image edge ((Fig. 36 / p. 62)).

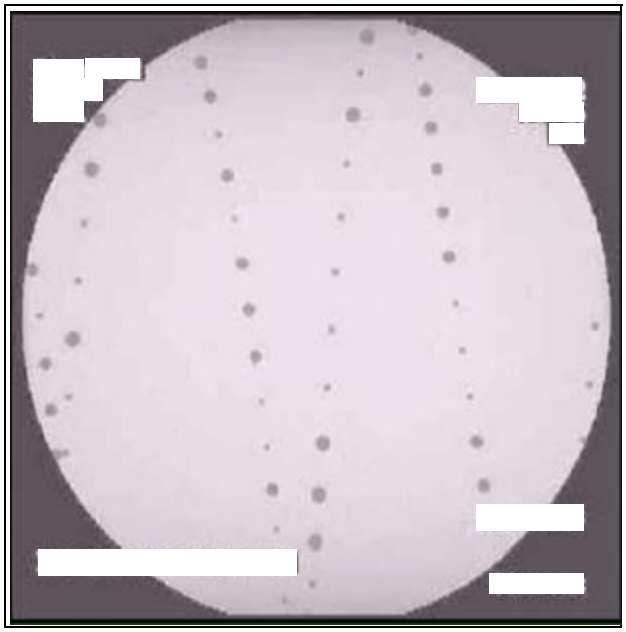

*Fig. 36: Positioning_*

Without 3D navigation

NOTE	**3D calibration is to be performed according to the description in the “Description Window”.**

Perform calibration completely.

Required material

3D calibration phantom	75 51 620 G5486

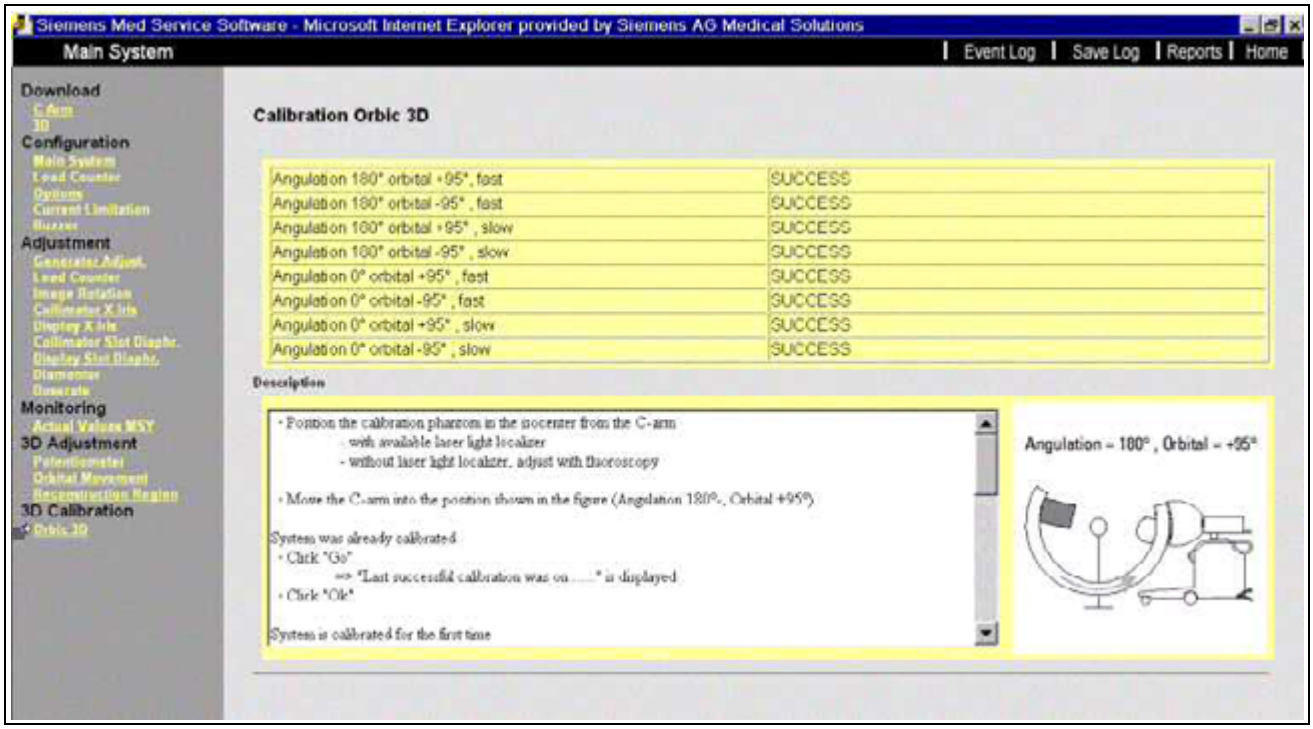

*Fig. 37: Calibration_*

	Factory		Place of use	
Calibration successful:	❒ Yes	❒ No	❒ Yes	❒ No

Calibration with mounted navigation attachment

Prerequisite:

The previously described 3D calibration without a navigation attachment must have been successfully performed (see above section: "Without 3D navigation").

NOTE

If more than one navigation system is used in combination with ARCADIS Orbic, the calibration is to be performed for every navigation system + each corresponding I.I. navigation attachment in cooperation with an engineer from the navigation company.

NOTE

The particular navigation attachment must be mounted on the I.I. via knurled screws/Allen wrench. The calibration must be performed together with the navigation system. Therefore, an engineer of the navigation company must also be present.

During calibration, the markers on the I.I. navigation attachment and the calibration phantom must be able to be recorded ("seen") by the cameras of the navigation system.

Ensure that the correct navigation system is selected in the calibration window.

- Select "3D calibration" (of the navigation system) in the service menu under "main system", and perform the 3D calibration with the mounted I.I. navigation attachment, see (Fig. 38 / p. 65).
- Calibration is to be performed according to the description in the description window, see (Fig. 37 / p. 63).
- Perform calibration completely.

Fig. 38: Navigation attachment

Checking the overall accuracy of the 3D navigation

NOTE

The overall accuracy after calibration must be checked together with the navigation system. Therefore, an engineer of the navigation company must also be present.

During the 3D exposure and the accuracy check, the markers on the I.I., test body and pointer must be detectable by the navigation system.

- Carefully attach the reference clamp to the test body (test body belongs to the customer).
- Position the test body in the isocenter of the ARCADIS Orbic 3D.
- Perform a 3D exposure and transfer the image data set to the navigation system.
- In three planes, move toward a marker cone with a pointer all the way into the tip of the marker cone as shown in (Fig. 39 / p. 66).

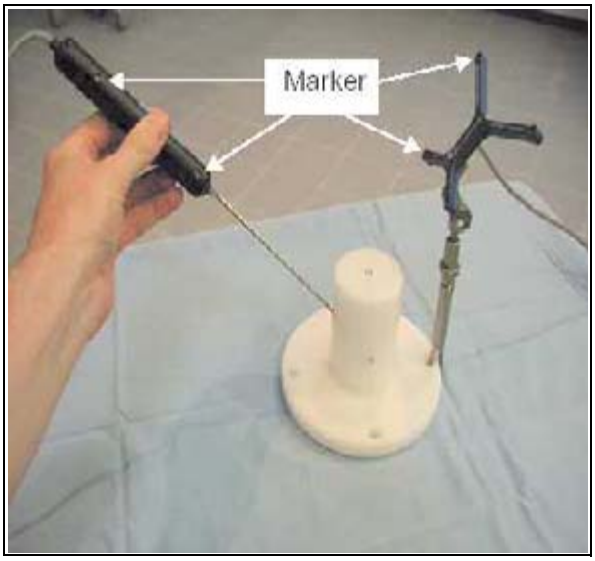

Fig. 39: Test_1

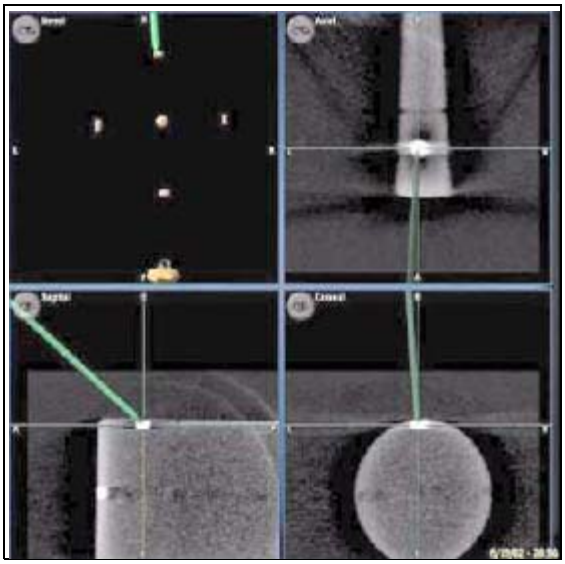

Fig. 40: Test_2

- The accuracy of the 3D navigation is proven if all three tips are within the marker cones shown on the navigation screen of the navigation company ((Fig. 40 / p. 67)).
- Complete the table, indicating the relevant navigation system.

Has the tip of the marker cone been reached	**by the pointer within the marker cone displayed on the navigation system?**		
	Navi-System	**Navi-System .....**	**Navi-System .....**
Plane 1 top			
Plane 2 center			
Plane 3 bottom			

The check of the overall accuracy of the 3D navigation has been successfully completed:

Name of Siemens engineer	Date	Signature
Name of navigation engineer.....	Date	Signature
Name of navigation engineer.....	Date	Signature
Name of navigation engineer.....	Date	Signature

Comments: _____

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Possible errors and corrective measures

Errors	Possible cause	Corrective measure
Calibration unsuccessful	Phantom positioned incorrectly	Position phantom correctly
Image distorted	Lead balls missing in the calibration phantom	Order new calibration phantom
Poor image quality after calibration	Calibration process	Check 3D limiting resolution and recalibrate, if necessary
Insufficient accuracy of the 3D navigation	Interface at the calibration phantom not clean or damaged	Perform visual check of calibration phantom for correct condition
	Navigation marker ring on I.I. not mounted correctly	Make sure the marker ring is mounted correctly.
	The grid holder at the I.I. is dirty	Clean the I.I. and the grid holder
No registration possible during calibration with marker ring. Calibration does not start.	Markers are not detected in the starting position	Contact engineer of navigation company
Calibration with 3D navigation unsuccessful	Navigation system faulty	Contact engineer of navigation company
Other	Other	Read error messages in the Eventlog Reader Analyze and process errors acc. to troubleshooting instructions

Ground wire test

- If ARCADIS Orbic covers were removed, perform the ground wire test according to ARTD, part 2 (CD-ROM).

Chapter: Introduction	/ under "Checking the monitors". “SIEMENS TFT monitor DSC 1904-D” added.
Chapter: Checking the ADR control characteristics	mAs setpoint changed to 3.6-5.9 mAs
Chapter: Capillary test	LUT SUB3 changed to LUT SUB2
Chapter: Capillary test	Tab. 5 - values corrected.